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ABSTRACT

Educators and industrial representatives developed these guidelines for school officials, instructors in technical education, and program and facility planners to use in planning a high school program in technical electromechanics. Designed to train students for entry into industry in applied electromechanics, the program includes electricity, basic electronics, fundamentals of mechanisms and appropriate general education subjects. Suggestions are given for organization and administration and for physical facilities and equipment. The program is outlined for grades 10-12, with course descriptions of the technical electromechanics courses. A job description of the electromechanical technical aide is included. (DM)

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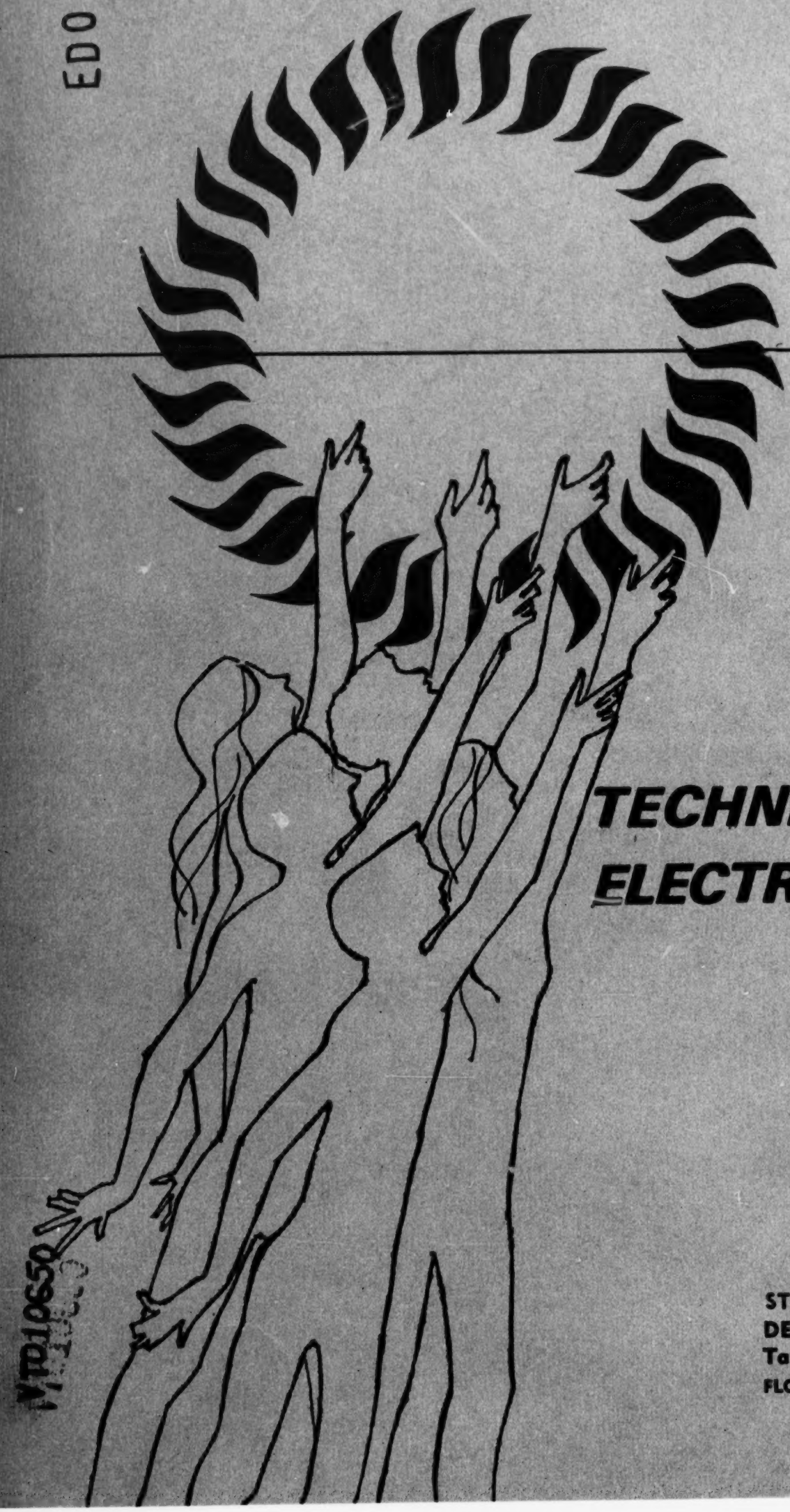

# GUIDELINES FOR ESTABLISHING AND EVALUATING HIGH SCHOOL TECHNICAL ELECTROMECHANICS PROGRAMS

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STATE OF FLORIDA
DEPARTMENT OF EDUCATION
Tallahassee, Florida
FLOYD T. CHRISTIAN, Commissioner

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# GUIDELINES FOR ESTABLISHING AND EVALUATING HIGH SCHOOL

# TECHNICAL ELECTROMECHANICS

## PROGRAMS

DIVISION OF VOCATIONAL,
TECHNICAL, AND ADULT EDUCATION

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TECHNICAL and HEALTH
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# F O R E W O R D

The publication of this bulletin is for the purpose of communicating to school officials, program and facility planners and instructors in technical education the essential concepts and requirements for an effective high school program in Technical Electromechanics. These guidelines have been cooperatively developed by educators and industrial representatives as a guide for establishing and evaluating these programs. They are not meant to be rigid or restrictive but are intended to provide assistance and guidance to persons charged with the responsibility of educating technical aides or assistants.

It is hoped that the materials presented in the publication will be useful in understanding the characteristics and special needs of this type of education on the secondary level. The graduate will be prepared to go to work immediately upon graduation or will have the necessary background to pursue several closely related options at the post secondary level in such technologies as electrical, electronics, mechanical, electromechanical, computer programming, data processing and instrumentation.

# GUIDELINES FOR ESTABLISHING AND EVALUATING HIGH SCHOOL TECHNICAL ELECTROMECHANICS PROGRAMS

## Overview

The goal of the high school electromechanical curriculum is to educate an entry level technical specialist or technical aide who is employable upon graduation or who is prepared to pursue post secondary education in this field.

The technical content of the curriculum is designed to provide a broad background of experience necessary for entry level employment in the field of applied electromechanics. The student is provided a basic foundation in electricity, basic electronics and fundamentals of mechanisms. He is also expected to pursue an appropriate general education program including subjects such as mathematics, English, social studies, physical education and the physical sciences. The program should be balanced between the practical and the theoretical.

The graduate of the program can expect to be employed in production facilities, the business machines industry, computer service centers and other industries producing, distributing and utilizing electromechanical devices.

## Purpose and Objectives

The purpose of the technical electromechanics program is twofold:

1. to prepare the student for employment upon graduation from high school
2. to prepare the student to pursue futher technical education at the post secondary level.

Objectives of the course are to develop within the student:

1. a working knowledge of the vocabulary associated with electromechanical technology
2. the ability to communicate effectively in the spoken and written form
3. the ability to adapt to changes brought about by new developments in technology and the social, business and organizational environment in which he will function
4. the ability to interpret and utilize the information provided by schematics, charts, graphs, drawings, flow charts and specifications
5. the ability to apply his knowledge to testing, analyzing and troubleshooting electromechanical devices
6. the ability to qualify for entry level employment in those industries employing electromechanical technicians and aides.

General Requirements

Organization and Administration

The high school technical electromechanics program may be established in secondary schools or area vocational-technical centers serving high school students.

The primary responsibility for administration and planning is assumed by school personnel. These responsibilities include organization and administration, periodic review, continued development, evaluation and general effectiveness of the educational program.

An advisory committee consisting of representatives of such organizations as the business machines industry, appliance production or maintenance industry, research and development laboratories, military

installations or other concerns producing, distributing and utilizing electromechanical equipment, is helpful to effective planning. It is recommended that this committee be appointed by the appropriate school authorities for a one or two-year term.

The organization and operation of the program shall be consistent with the requirements of the State Plan for the Improvement of Vocational, Technical and Related Educational Services and the policies of the State Board for Vocational Education. It shall be based on standards recommended by the Technical and Health Occupations Education Section, Division of Vocational, Technical and Adult Education, Department of Education, State of Florida.

Selection of students should be made by the school guidance and counseling staff in cooperation with those directly responsible for the education program. All applicants should be required to have the appropriate abilities and aptitudes for such a program.

## General Plan of Instruction

The secondary electromechanical program is three years in length, beginning in grade ten. It includes classroom and laboratory experiences carefully correlated to carry out the objectives of the program. The faculty is urged to use selected field trips to visit business and industry.

### Admission Requirements

The effectiveness of a technical program depends upon the quality of the instructor(s) and the capacity, ability and aptitude of the students. The individual seeking admission to the program should have

at least average scholastic ability, a mechanical aptitude and good motivation.

Effective guidance and counseling is essential.

Description of the Program

The primary aim of this program is to prepare high school graduates to become electromechanical technical aides or technical specialists and to be able to function in the occupation.

The curriculum includes both classroom and laboratory learning experiences. The correlation of these experiences should be carefully planned to insure an educationally sound program.

The mathematics and sciences required for the technical specialist or technical aide do not vary greatly from many of today's high school programs. The key is to the teaching method or approach. The emphasis should be on the practical application and use of mathematics and science rather than on a theoretical approach involving rigorous proofs. A good working relationship between the respective instructors will make the program more effective.

A sound knowledge of written and oral communications is essential to the technical specialist or technical aide. It is hoped that the school will provide experiences including speaking and report writing.

A SUGGESTED PROGRAM CONTENT

Grade 10

| | |
|---|---|
| English II | 1 unit |
| *Algebra I | 1 unit |
| Science | 1 unit |
| **Social Studies | 1 unit |
| Physical Education | 1 unit |
| Technical Electromechanics I | 1 unit |

*If Algebra I is taken in grade 9, Algebra II may be taken at this time.
**If a social studies course such as civics, world history, or world geography is taken in grade 9, one elective may be taken at this time.

Grade 11

| | |
|---|---|
| English III | 1 unit |
| *Algebra II | 1 unit |
| American History and/or Americanism vs. Communism | 1 unit |
| **Physical Education | 1 unit |
| Technical Electromechanics II, III | 2 units |

*If Algebra II is taken in grade 10, trigonometry may be taken at this time.
**If it is not desired to take physical education, one elective may be taken at this time.

Grade 12

| | |
|---|---|
| English IV | 1 unit |
| *Trigonometry | 1 unit |
| **Physical Education | 1 unit |
| Technical Electromechanics IV, V | 2 units |
| Elective | 1 unit |

*If trigonometry is taken in grade 11, one elective may be taken at this time.
**If it is not desired to take physical education, one elective may be taken at this time.

NOTE: If trigonometry and physical education are not taken during grade 12, the student will have enough elective time available to enable him to participate in a cooperative work arrangement with an electromechanical industry for one-half of each day.

Course Description

Technical Electromechanics I, Grade 10

Emphasis is placed on learning the fundamentals of electricity and electronics. Course content includes the electron theory, circuit components, AC and DC sources and simple series and parallel circuits with typical applications.

Technical Electromechanics II, Grade 11 (1st semester)

Emphasis is on basic control devices and their applications. Vacuum tube and transistor characteristics and circuits are studied and applied to typical devices such as power supplies, oscillators and amplifiers. The basic characteristics of each device and circuit are examined in the laboratory.

Technical Electromechanics III, Grade 11 (2nd semester)

This course builds upon the fundamental concepts and relationships of physics, including electricity and electronics. The course also includes the basic elements of mechanics such as levers, gears, cams, pneumatic and hydraulic devices and electromagnetic actuators.

Technical Electromechanics IV, Grade 12A (1st semester)

The objective of this course is to develop knowledge and skills concerning methods of transmitting, translating, controlling, timing, synchronizing and converting energy and motion. The basic knowledge acquired by the student is applied to electromechanical devices and systems.

Technical Electromechanics V, Grade 12 (2nd semester)

This course develops the skill of the student in utilizing available information such as schematics, charts, graphs, specifications

and blueprints in the logical troubleshooting of electromechanical systems. The course also extends the knowledge of the student to include more complex and sophisticated systems.

## Physical Facilities and Equipment

High schools or area vocational-technical centers offering the technical electromechanics program should plan carefully to allow for the needs of the industries they serve and to allow for advances and changes in facility requirements. The facilities and the equipment should approximate those generally accepted by industry. The schools should maintain close communication with competent advisory committees to insure that the training facilities are attuned to new methods and applications as utilized by industry.

Some specific suggestions for consideration are:

Facilities needed:

Space Allocation:

1. 75 square feet per student.
2. 100 square feet per instructor.
3. Allowance for storage and equipment room (10-20 square feet per student.)
4. If the classroom facilities are not included in the laboratory, a classroom near the laboratory is desirable.

Classroom for teaching theory (whether separate or combined):

1. If separate, the classroom should contain a minimum floor area of 600 square feet.
2. Classroom should contain student desks, chalkboards, projection screens and tackboard.
3. Classroom should be well lighted with provision for controlling the lights in such a way as to facilitate the use of visual aids. All lighting should be designed to meet the needs of night classes.

4. Electrical outlets should be provided for demonstration and projection equipment.

5. A storage area for visual aids and lecture equipment should be located within or adjacent to the classroom facilities.

Laboratory (general characteristics):

1. Appropriate for the strengthening of technical knowledge and skills.

2. Convenient for the students and instructors.

3. Work stations should accommodate at least two students.

4. Storage area for instruments and equipment should be located adjacent to the laboratory so that the instructor can readily control the movement of stock, instruments and equipment. Some display type storage case should be considered for items such as meters.

5. Should be equipped with sink, chalkboard and tackboard.

6. Doors should provide for easy flow of traffic in and out of the laboratory.

7. Power control for all utilities should be centralized within easy reach of the instructor.

8. The electrical service to each work station should be on a separate circuit breaker.

9. Electrical wiring to work stations should be through overhead busbars or through subfloor channels.

10. Door openings should be consistent with the size of equipment to be moved through them.

11. A drinking fountain should be located in the laboratory vicinity.

12. All electrical equipment should be provided with grounds.

13. An adequate office for the instructor should be located conveniently to the laboratory.

## Occupational Educational Cluster

### Definition

The electromechanical technical aide or technical specialist assists or supports the engineer or scientist in the development, design or main-

tenance of the various electromechanical instruments and controls such as servo-control mechanisms, inertial guidance systems, telephone switching equipment, fire control systems, electro-pneumatic instruments and computers.

**Functions**

An experienced electromechanical technical aide or technical specialist may perform one or more of the following functions in design, development or maintenance:

Work from engineering specifications, sketches and drawings to assist in the design of electromechanical systems, instruments and controls.

Utilize data and information in the form of handbooks and charts on various components from reference sources to make necessary calculations.

Draw preliminary sketches and layouts and determine items that require futher consideration in final design.

Determine whether standard components can be used in the design of the equipment.

Prepare final layouts, detailed working or assembly drawings and supervise other personnel in the preparation of drawings.

Interpret schematic and line diagrams relating to electromechanical systems.

Construct or supervise the construction of prototypes.

Troubleshoot, diagnose, locate and correct malfunctions in units under test.

Evaluate tests and projects by preparing reports including the necessary charts, diagrams and graphs.

Align, calibrate, test and troubleshoot components and electromechanical systems.

**Technical Skills Required**

Must be able to read and interpret engineering drawings, electrical and electronic schematics, blueprints and line drawings.

Must be able to prepare technical reports concerning tests and evaluations.



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Must be able to use the various tools and instruments needed to service and maintain electromechanical systems.


Summary

This publication is intended as a recommended guide for program planning and development at the high school level. It is expected that adaptations may need to be made to suit various situations in different institutions.

There is definitely an established need for electromechanical technical specialists and technical aides and according to the industry, the demand is increasing. Strong high school programs properly designed to prepare persons for employment in this field are needed.